```
import pandas as pd
import numpy as np
from sklearn.model_selection import KFold
import matplotlib.pyplot as plt
import sklearn
from sklearn.model_selection import train_test_split
from sklearn import datasets, linear_model
from sklearn.preprocessing import StandardScaler
from scipy.cluster.hierarchy import linkage,fcluster
from sklearn import metrics
import seaborn as sns
from sklearn.cluster import KMeans, DBSCAN
import plotly.figure_factory as ff
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
# Import the CSV file
import pandas as pd
df = pd.read_csv("/content/drive/My Drive/FinalProject_ChicagoCrime/Merge_1.csv")
df.head()
```

	District	index	Case Number	Date	Block	IUCR	Primary Type	Description	Location Description	Arrest	Domestic	Beat	Ward	Community Area	FBI Code	X Coordinate	Coordina
0	4	2	JB528220	11/24/2018	095XX S STONY ISLAND AVE	0261	CRIM SEXUAL ASSAULT	AGGRAVATED: HANDGUN	ALLEY	1	0	431	7.0	51.0	02	1188521.0	184211
1	22	3	JB495848	08/27/2018	092XX S UNION AVE	1120	DECEPTIVE PRACTICE	FORGERY	RESIDENCE	1	0	2223	21.0	73.0	10	1173264.0	184355
2	7	5	JB505888	09/27/2018	068XX S PERRY AVE	1020	ARSON	BY FIRE	VEHICLE NON-COMMERCIAL	1	0	722	6.0	69.0	09	1176575.0	185972
3	24	6	JB472665	10/12/2018	061XX N BROADWAY	0890	THEFT	FROM BUILDING	COMMERCIAL / BUSINESS OFFICE	1	0	2433	48.0	77.0	06	1167199.0	194057
4	8	9	JB241744	04/27/2018	070XX S CALIFORNIA AVE	1562	SEX OFFENSE	AGG CRIMINAL SEXUAL ABUSE	APARTMENT	0	1	831	17.0	66.0	17	1158921.0	185792

```
df['ArrestLabel']=df['Arrest']
df.head()
```

	District	index	Case Number	Date	Block	IUCR	Primary Type	Description	Location Description	Arrest	Domestic	Beat	Ward	Community Area	FBI Code	X Coordinate	Coordina
0	4	2	JB528220	11/24/2018	095XX S STONY ISLAND AVE	0261	CRIM SEXUAL ASSAULT	AGGRAVATED: HANDGUN	ALLEY	1	0	431	7.0	51.0	02	1188521.0	184211
1	22	3	JB495848	08/27/2018	092XX S UNION AVE	1120	DECEPTIVE PRACTICE	FORGERY	RESIDENCE	1	0	2223	21.0	73.0	10	1173264.0	184355
2	7	5	JB505888	09/27/2018	068XX S PERRY AVE	1020	ARSON	BY FIRE	VEHICLE NON-COMMERCIAL	1	0	722	6.0	69.0	09	1176575.0	185972
3	24	6	JB472665	10/12/2018	061XX N BROADWAY	0890	THEFT	FROM BUILDING	COMMERCIAL / BUSINESS OFFICE	1	0	2433	48.0	77.0	06	1167199.0	194057
4	8	9	JB241744	04/27/2018	070XX S CALIFORNIA AVE	1562	SEX OFFENSE	AGG CRIMINAL SEXUAL ABUSE	APARTMENT	0	1	831	17.0	66.0	17	1158921.0	185792

```
#Dropping column
df=df.drop(columns=['Arrest'])
df.rename(columns={'ArrestLabel':'Arrest'},inplace=True)
df.head()
```

	District	index	Case Number	Date	Block	IUCR	Primary Type	Description	Location Description	Domestic	Beat	Ward	Community Area	FBI Code	X Coordinate	Y Coordinate	Lati
0	4	2	JB528220	11/24/2018	095XX S STONY ISLAND AVE	0261	CRIM SEXUAL ASSAULT	AGGRAVATED: HANDGUN	ALLEY	0	431	7.0	51.0	02	1188521.0	1842119.0	41.7
1	22	3	JB495848	08/27/2018	092XX S UNION AVE	1120	DECEPTIVE PRACTICE	FORGERY	RESIDENCE	0	2223	21.0	73.0	10	1173264.0	1843551.0	41.7
2	7	5	JB505888	09/27/2018	068XX S PERRY AVE	1020	ARSON	BY FIRE	VEHICLE NON-COMMERCIAL	0	722	6.0	69.0	09	1176575.0	1859723.0	41.7
3	24	6	JB472665	10/12/2018	061XX N BROADWAY	0890	THEFT	FROM BUILDING	COMMERCIAL / BUSINESS OFFICE	0	2433	48.0	77.0	06	1167199.0	1940579.0	41.9
4	8	9	JB241744	04/27/2018	070XX S CALIFORNIA AVE	1562	SEX OFFENSE	AGG CRIMINAL SEXUAL ABUSE	APARTMENT	1	831	17.0	66.0	17	1158921.0	1857929.0	41.7

```
df=df.drop(columns=['Beat','Ward','Latitude','Longitude','p_x','p_y','p_latitude','p_longitude','Case Number','Block','FBI Code','Date','p_dname','Primary Type','Se
df=df.drop(columns=["Description","Location Description","Domestic","Community Area","X Coordinate","Y Coordinate","Month","Day"])
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 485344 entries, 0 to 485343
Data columns (total 7 columns):
District       485344 non-null int64
index          485344 non-null int64
IUCR           485344 non-null object
Distance       485344 non-null float64
Time           485344 non-null object
crimeGroups    485344 non-null int64
Arrest         485344 non-null int64
dtypes: float64(1), int64(4), object(2)
memory usage: 25.9+ MB
```

```
#making dummy variables out of the object variables
#df_dum= pd.get_dummies(df)
#df_dum.head()
#data['Ntime'] = (data['seconds'] - data['seconds'].min())/(data['seconds'].max()-data['seconds'].min())
df['IUCR Cat']=df['IUCR'].astype("category").cat.codes
X = df.drop(columns=["crimeGroups","Arrest","IUCR","Time"])
y = df[["crimeGroups"]]
print(X.shape, y.shape)
```

```
(485344, 4) (485344, 1)
```

```
X.head
```

```
<bound method NDFrame.head of         District   index      Distance  IUCR Cat
0              4       2   6822.245420         2
1             22       3  14717.784521       103
2              7       5   9500.832396        97
3             24       6   3987.355350        84
4              8       9   6432.894093       177
...          ...     ...           ...       ...
485339         8  224407   7287.873953       101
485340         7  224408   4288.521873       101
485341         7  224409   1541.306056       101
485342         5  224410   6056.942572       101
485343         6  224411   2708.275085       101

[485344 rows x 4 columns]>
```

```
y['crimeGroups'].unique()
```

```
array([1, 3, 2, 4, 5])
```

```
#Dividing the data into Train and Test set
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size = 0.2, random_state=0)
```

```
scaler = StandardScaler()
scaler.fit(X_train)
X_scaled = scaler.transform(X_train)
```

```
X_scaled[0:1]
```

```
array([[ 0.83953522, -1.02231969, -1.03376793, -0.58829716]])
```

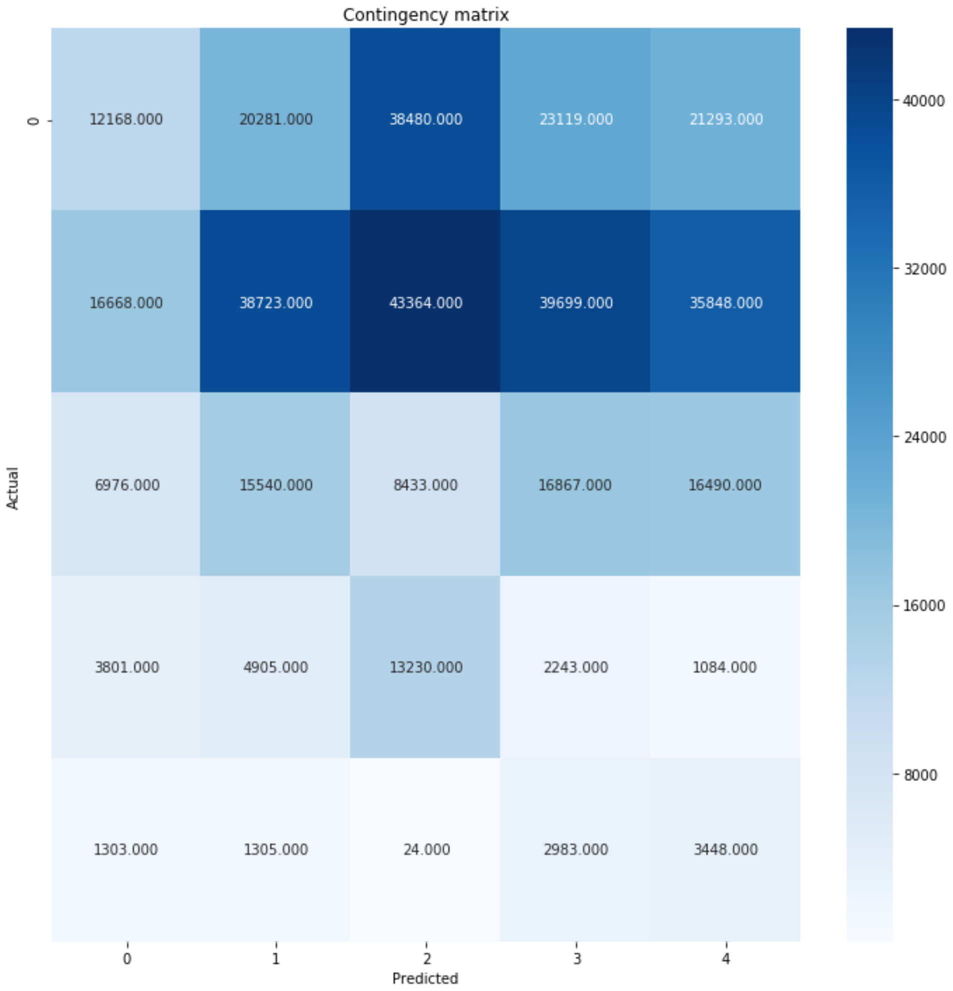
```
clustering = KMeans(n_clusters = 5, init = 'k-means++', n_init = 20,random_state=0).fit(X_scaled)
clusters = clustering.labels_
```

```
clusters[0:5]
```

```
array([1, 3, 2, 4, 3], dtype=int32)
```

```
X_train['clusters'] = clusters - 1
```

```
cont_matrix = metrics.cluster.contingency_matrix(y_train,X_train['clusters'])
fig, ax = plt.subplots(figsize=(10,10))
ax=sns.heatmap(cont_matrix, yticklabels=5, annot = True, fmt = ".3f", square = False, cmap = plt.cm.Blues)
plt.ylabel('Actual')
plt.xlabel('Predicted')
plt.title('Contingency matrix')
plt.tight_layout()
```



```
X_train['clusters'].shape
```

```
(388275,)
```

```
Y=np.squeeze(y_train)
```

```
adjusted_rand_index = metrics.adjusted_rand_score(Y, X_train['clusters'])
silhouette_coefficient = metrics.silhouette_score(X_scaled, clusters, metric = "euclidean")
print([adjusted_rand_index, silhouette_coefficient])
```

```
[0.010991363429064 24, 0.22473666853860663]
```

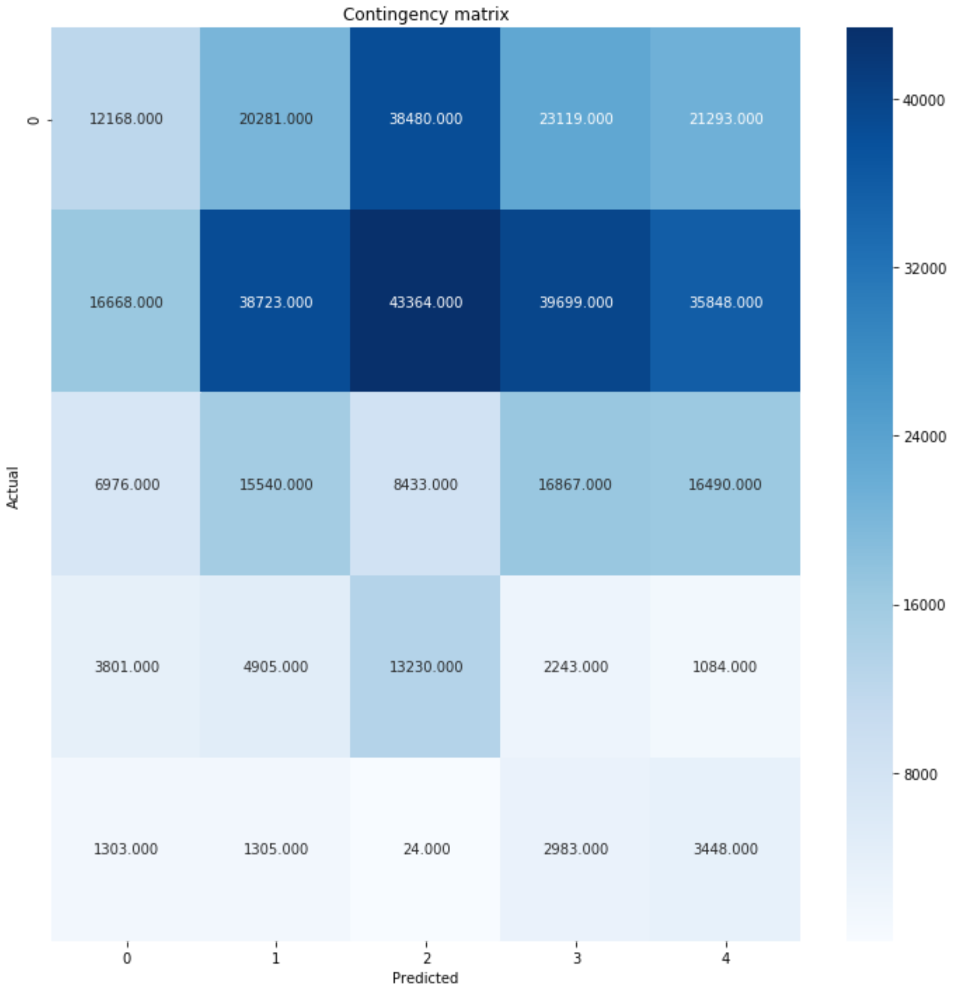
```
clustering = KMeans(n_clusters = 5, init = 'random', n_init = 10,random_state=0).fit(X_scaled)
clusters = clustering.labels_
```

```
clusters[0:5]
```

```
array([2, 1, 0, 3, 1], dtype=int32)
```

```
X_train['clusters'] = clusters - 1
```

```
cont_matrix = metrics.cluster.contingency_matrix(y_train,X_train['clusters'])
fig, ax = plt.subplots(figsize=(10,10))
ax=sns.heatmap(cont_matrix, yticklabels=5, annot = True, fmt = ".3f", square = False, cmap = plt.cm.Blues)
plt.ylabel('Actual')
plt.xlabel('Predicted')
plt.title('Contingency matrix')
plt.tight_layout()
```



```
X_train['clusters'].shape
```

```
(388275,)
```

```
Y=np.squeeze(y_train)
```

```
adjusted_rand_index = metrics.adjusted_rand_score(Y, X_train['clusters'])
silhouette_coefficient = metrics.silhouette_score(X_scaled, clusters, metric = "euclidean")
print([adjusted_rand_index, silhouette_coefficient])
```

```
[0.01127587904198441, 0.22532772840833132]
```

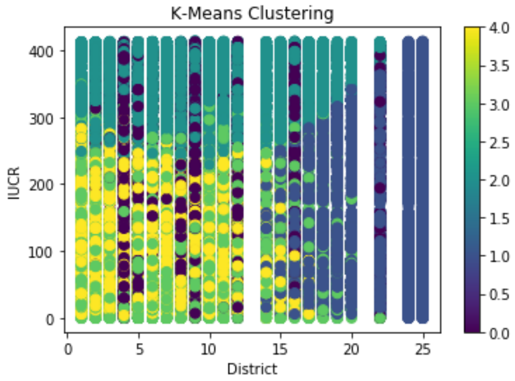
```
kmeans = pd.DataFrame(clusters)
```

```
kmeans[0]
```

```
0         1
1         3
2         2
3         4
4         3
         ..
388270    2
388271    0
388272    3
388273    2
388274    2
Name: 0, Length: 388275, dtype: int32
```

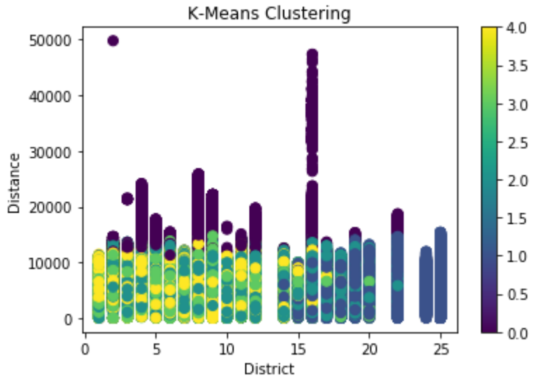
```
fig = plt.figure()
ax = fig.add_subplot(111)
scatter = ax.scatter(X_train['District'],X_train['IUCR Cat'],
                     c=kmeans[0],s=50)
ax.set_title('K-Means Clustering')
ax.set_xlabel('District')
ax.set_ylabel('IUCR')
plt.colorbar(scatter)
```

```
<matplotlib.colorbar.Colorbar at 0x7f0bad222ac8>
```



```
fig = plt.figure()
fig = plt.figure()
ax = fig.add_subplot(111)
scatter = ax.scatter(X_train['District'],X_train['Distance'],
                     c=kmeans[0],s=50)
ax.set_title('K-Means Clustering')
ax.set_xlabel('District')
ax.set_ylabel('Distance')
plt.colorbar(scatter)
```

```
<matplotlib.colorbar.Colorbar at 0x7f0bab94e7b8>
```



```
clustering = DBSCAN(eps = 5, min_samples = 7, metric = "euclidean").fit(X_scaled)
clusters = clustering.labels_

cont_matrix = metrics.cluster.contingency_matrix(ytrain,clusters)
sns.heatmap(cont_matrix, annot = True, fmt = ".3f", square = True, cmap = plt.cm.Greens)
plt.ylabel('Actual')
plt.xlabel('Predicted')
plt.title('Contingency matrix')
plt.tight_layout()

adjusted_rand_index = metrics.adjusted_rand_score(ytrain, clusters)
silhouette_coefficient = metrics.silhouette_score(X_scaled, clusters, metric = "euclidean")
print([adjusted_rand_index, silhouette_coefficient])
```